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Filing Date	07/22/2003
First Named Inventor	MONKS, S. et al.
Art Unit	3641
Examiner Name	
Attorney Docket Number	P034 P00888-US

Total Number of Pages in This Submission: 2

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Firm or Individual name	David R. Josephs, Esquire, Reg. No. 34,632 Barlow, Josephs & Holmes, Ltd.
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2. Patent application number *(The Patent Office will fill in this part)* — 0217099.1 — 24 JUL 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

PLANET ECLIPSE LIMITED
Units 7 & 8 Southfield Industrial Estate,
Praed Road,
Trafford Park,
Manchester, M17 1 SJ.

Patents ADP number *(if you know it)* 8431355001

If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom

4. Title of the invention

ELECTRONIC GRIP-FRAME FOR A PAINTBALL MARKER

5. Name of your agent *(if you have one)*

WILSON GUNN M'CAW

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

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Manchester,
M2 7BD

Patents ADP number *(if you know it)* 7153927001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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Signature Watson Lynn McCann Date 23 July 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

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ELECTRONIC GRIP-FRAME FOR A PAINTBALL MARKER

This invention relates to a grip frame. The frame is intended to form an integral part of a paintball marker and to be supplied as an upgrade for existing paintball markers.

A paintball marker, also known as a paintball gun or paintball launcher, is a device used to propel paintballs. A paintball is a spherical object typically 0.68 inch diameter, comprised of a fragile shell which encapsulates a coloured liquid. When a paintball that has been launched from a paintball marker comes into contact with a hard surface, the shell of the paintball ruptures and the coloured liquid is released, leaving a bright mark on the surface.

One type of paintball marker is a mechanically operated marker. With this type of marker the user pulls a trigger which, through the use of a mechanical linkage, releases a spring-loaded hammer. This hammer is pushed forward by the compressed spring and strikes a spring loaded valve pin, causing the valve to open for a short time and release a burst of compressed gas. This gas burst is internally diverted through the marker such that it passes through a bolt and into the breech of the marker behind a paintball. The expanding gas accelerates the paintball out of the breech, along a barrel and out of the end of that barrel. The continued pull on the trigger actuates a mechanically operated pneumatic valve, which supplies compressed gas to one side of a pneumatic

cylinder. This cylinder pushes the hammer back to its starting position and also retracts the bolt to reveal a feed aperture through which a second paintball can drop into the breech. The release of the trigger switches the pneumatic valve back to its original position, supplying compressed gas to the opposite side of the pneumatic cylinder and pushing the bolt back to its original position thus causing the second paintball to be pushed into its firing position, ready for the cycle to start again.

Another type of paintball marker is an electro-pneumatic marker. This type of marker functions in much the same way as the mechanically operated marker with the exception that the trigger no longer provides the mechanical action required to operate the marker. The trigger in this type of marker operates an electrical switch, which is interpreted by an electrical circuit as the signal to start the firing cycle. This electrical circuit typically employs electro-pneumatic solenoid valves, which drive pneumatic cylinders in order to create the movement necessary to fire and re-cock the marker.

An electro-pneumatic paintball marker has a much higher rate of fire than a mechanically operated paintball marker and this is a major advantage in modern paintball. The grip frame of the invention is intended for fitting onto a mechanically operated paintball marker in order to convert that marker into an electro-pneumatic marker and thus increase the rate of fire of the marker. The inventive grip frame replaces the entire

grip frame of an existing paintball marker along with the hammer release mechanism and the mechanically operated pneumatic valve.

According to the present invention there is provided a grip frame for a paintball marker or the like comprising a handle, a trigger mechanism associated with the handle comprising a trigger and an electronic sensor associated with the trigger for determining when the trigger has been activated.

In a preferred embodiment of the invention, the sensor may be optical. Stop means may be provided for limiting the travel of the trigger. The stop means may comprise two adjustable stops limiting travel in opposite directions. Magnetic means may be provided to urge the trigger back to its rest position. Display means may be provided for providing information to the user disposed on that face of the handle facing the user in normal use. These display means may comprise an LED or a liquid crystal display. Advantageously, the display is a multicharacter display. Pushbuttons may be provided in the handle for calibration purposes. The frame may be made of metal or plastics or a combination of both but other materials may also be used. The invention also comprises a paintball marker including a grip frame as defined above. The marker comprises a breech and barrel connected to the grip frame. Advantageously a sensor for sensing the presence of an object in the breech is provided.

Specifically the breech sensor is used to detect the presence of objects at a position in the breech below the feed aperture through which

the paintballs enter the breech. This sensor is used to detect that a paintball is in the breech before the bolt can travel forwards thus preventing the bolt from breaking a ball that has not completely passed through the feed aperture, a major problem when trying to operate other paintball markers at high rates of fire. The sensor is also used to detect that the bolt is fully forwards prior to the marker being fired, thus preventing gas from escaping the breech through the feed aperture and ensuring maximum gas efficiency.

As the trigger does not operate an electrical switch, as in the case in other paintball markers, but senses the movement of the trigger by means of a sensor, moving parts are reduced which makes the marker more reliable than other paintball markers.

The use of a magnet and adjustable screw in order to set the amount of force required to actuate the trigger is an improvement over other paintball markers where the trigger operating force can only be varied by replacing a trigger return spring.

The LED display provides improved viewing in low light conditions over the LCD displays used on other paintball markers. Mounting the display at the rear of the grip frame allows the user to view the display without having to move the paintball marker from its shooting position. This is an improvement over the other paintball markers where displays are mounted on either the side of the marker or the side of the grip frame.

Electrical elements form parts of an electronic circuit which is advantageously battery powered. The battery used to power the

electronic circuit makes electrical contact with the related circuit board by means of leaf spring contacts. This is an improvement over other paintball markers which use battery straps on flying leads as these leads often break with use.

Longevity for the original marker is increased by providing a means to upgrade rather than replace the marker.

In order that the invention may be more clearly understood, one embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 shows a side elevational view of a typical, mechanically operated paintball marker.

Figure 2 shows a perspective view of an electronic grip frame with sear solenoid in place,

Figures 3a, 3b and 3c respectively show a side elevational view, end elevational view and plan view of the electronic grip frame of figure 2 with electronic circuit board and battery in place;

Figures 4a and 4b respectively show side and end elevational views of a trigger and trigger sensor forming part of the grip frame of figure 2,

Figures 5a, 5b, 5c and 5d respectively show a side elevational view, plan view, underplan view and end elevational view of a cocking solenoid and protective manifold forming part of the grip frame of figure 2.

Figure 6 diagrammatically shows a hammer release assembly for the grip frame of figure 2.

Figure 7 shows a drawing in partial section of a paintball marker in one operative position

Figure 8 shows a drawing in partial section of a paintball marker in a second operative position.

Figure 9 shows a drawing in partial section of a paintball marker in a third operative position.

Figure 10 shows a functional block circuit diagram for the grip frame of figure 2,

Figures 11a and 11b show timing diagrams for the paintball marker of figures 7 to 9, and

Figure 12 illustrates one possible menu layout for the user interface for the grip frame of figure 2.

Referring to Figure 1, the mechanically operated paintball marker comprises a grip frame 1 firing mechanism comprising body 2 defining a breech 2a and barrel 3. Referring to figures 2, 3a 3b and 3c, an electronic grip frame 21 to replace the mechanical grip frame 1 is shown. Grip frame 21 comprises a handle 22 defining a cavity 23 in which an electronic circuit board 24 and an electrical battery 25 are located. Above this cavity 23 is a second cavity in which a hammer release assembly comprising a sear solenoid 26, pin 28 and sear 27 is disposed. This hammer release assembly is controlled by a trigger 29 which is protected by a trigger guard 30 to reduce the possibility of accidental operation. The

hammer release assembly will be described in more detail later with reference to figure 6.

The trigger 29 can be operated by either one or two fingers, the trigger guard 30 being large enough to accommodate two fingered operation. At the rear of the grip frame three recessed holes 9, 10 and 11 provide access to three tactile pushbuttons 12, 13, 14 mounted on the electronic circuit board 24. This recessing prevents accidental operation of the pushbuttons. Also at the rear of the grip frame, below the pushbutton holes 9, 10 and 11 is a transparent window 15 through which can be viewed a multi-character, alphanumeric LED (light emitting diode) display 16. A slider type switch 17 is located towards the rear of the frame 21 and is used to switch the electrical supply to the electronic circuit board 24. Channels 18 are cut into the grip frame for the purpose of routing interconnecting cables.

Referring to figures 4a and 4b, trigger 29 pivots on a pin 19 that passes through the body of the grip frame 21. The trigger 29 is held onto the pin 19 by means of a set screw 20. A second set screw 31 locates in a threaded hole through the front of the trigger and acts as a trigger stop. This set screw 31 can be screwed into or out from the hole in order to vary the maximum travel of the trigger 29. A third set screw 32 locates in a threaded hole through the top of the trigger and also acts as a trigger stop. This set screw 32 can be screwed into or out from the hole in order to vary the rest position of the trigger 29. A small magnet 35 is located in the grip frame above a fourth set screw 33. This magnet

attracts the set screw 33, ensuring that the trigger 29 returns to its rest position when released. A prong 34 protrudes from the rear of the trigger 29 passing through a slot in the grip frame 21. When the trigger 29 is operated the prong 34 passes through a slotted optical sensor 35, which is mounted on the electronic circuit board 24 causing the sensor 35 to detect that the trigger 29 has been operated.

Referring to figures 5a, 5b, 5c and 5d, the cocking solenoid assembly is shown. This comprises an electro-pneumatic solenoid valve 36 mounted onto a protective manifold 37. The manifold 37 would normally be attached to the front of the paintball marker in place of the existing mechanically operated valve, but it could possibly be mounted elsewhere on the marker. The manifold has pneumatic connections 38 that connect to the existing pneumatics on the paintball marker. The solenoid valve 36 is electrically connected to the electronic circuit board 24 by means of insulated wire 39 and the switching of the valve 36 is controlled by the electronics on the circuit board 24.

Referring to figure 6 the hammer release assembly is diagrammatically shown. This comprises the sear solenoid 26 which is an electro mechanical solenoid, which is connected to the electronic circuit board 24 and is controlled by the electronics on that board. When the sear solenoid 26 is energised it pushes onto one end of the sear 27 against the action of a sear spring 37 which pivots on pin 28 and releases a spring loaded hammer 40 located in the main body 2 of the paintball marker. When the sear solenoid 26 is de-energised both the sear 27 and

the sear solenoid 26 are returned to their rest positions by the sear spring 37.

Referring to figure 7, a paintball feed tube 42 leads to breech 2a. An optical breech sensor 43 is disposed in the breech 2a. The firing mechanism comprises a bolt 44 which is shown in its rest position in figure 7 and in its cocked position in figure 8. In both of these figures a paintball 45 is shown in the paintball feed tube 42 just above the breech 2a. In the position shown in figure 7, the bolt 44 prevents movement of the paintball 45 into the breech 2a. Cocking the bolt 44 by withdrawing it (to the left in figure 7 and 8) as shown in figure 8 permits the paintball 45 to drop from the paintball feed tube 42 into the breech 2a as shown in figure 9.

The electronics on the electronic circuit board 24 comprise a microprocessor 50 which operates to control the functions of the paintball marker under the control of a number of control parameters which are stored in the microprocessor 50 and which may be modified through the pushbuttons 12, 13 and 14. The operation of the paintball marker will now be described with additional reference to figure 10 which shows a functional block circuit diagram, figures 7-9 which show the paintball marker in its operative positions and figures 11a and 11b which show timing diagrams. Each timing diagram shows voltage as the ordinate plotted against time on the abscissa for the trigger sensor 35, sear solenoid drive 26, cocking solenoid drive 36 and breech sensor 43. The diagram of figure 11a shows the position which obtains when a paintball

is present in the breech and the diagram of figure 11b shows the position when there is no paintball present in the breech. In the former case, the cocking solenoid is de-energised when a paintball is sensed and in the latter case the cocking solenoid is de-energised after a predetermined time if no paintball is sensed.

Figure 7 shows the operative position of the paintball marker prior to the user pulling the trigger 29. When the user pulls the trigger 29, the movement of the trigger 29 is detected by the trigger sensor 35 and a digital signal is passed to the microprocessor 50. The microprocessor 50 then starts the firing cycle by energising the sear solenoid 26 for a short period of time referred to as the sear solenoid on time (SON). This causes the sear 27 to be pivoted and the hammer 40 to be released. The hammer 40 strikes a pin valve and releases a burst of gas, causing the paintball 45 in the breech 2a to be propelled from the marker. A short time later after the cocking solenoid on delay (CDEL), the microprocessor 50 energises the cocking solenoid valve 36, which passes compressed gas to one side of a pneumatic cylinder which pushes the hammer 40 back into its rest position whilst retracting the bolt 44 and opening an aperture that allows a second paintball 45 to fall into the breech 2a as shown in figure 8. Prior to the fall of the second paintball 45 into the breech 2a, the breech sensor 43 detects that the bolt 44 has retracted and that the breech is empty and an analogue signal is passed to the microprocessor 50. Some time later a paintball passes through the feed aperture and is detected by the breech sensor 43 as shown in figure 9.

The microprocessor 50 de-energises the cocking solenoid valve 36 which returns the bolt 44 to its rest position, closing the aperture and pushing the paintball 45 further into the breech 2a as shown in figure 7. If no paintball 45 is detected then the microprocessor will de-energise the cocking solenoid valve 36 after a predefined time referred to as the cocking solenoid on time 1 (CON1). The breech sensor 43 detects that the bolt 44 is closed and, a short time later, the firing cycle is completed and can be restarted with another trigger pull.

As mentioned above, the way in which the marker operates is defined by number of control parameters which are stored within the microprocessor 50. The user can modify these control parameters by means of the pushbuttons 12, 13, 14 and the LED display 16. Each control parameter is accessed through a series of menus and figure 10 shows one possible menu layout. This comprises a main menu 60 and a number of subsidiary menus 61, 62, 63. To scroll down through the options on each menu, the user presses the lower pushbutton 14. To scroll up through the options the user presses the upper pushbutton 12. To select an option the user presses the centre pushbutton 13. Each subsidiary menu comprises a BACK option. Selecting the BACK option from any menu takes the user back to the previous menu. Once a control parameter is selected then the current value of that control parameter is displayed. Pressing either of the upper or lower pushbuttons at this time takes the user back to the menu from which the control parameter was selected, whereas pressing the centre pushbutton 13 causes the value to

flash. When flashing, the parameter can be incremented by pressing the upper pushbutton 12 or decremented by pressing the lower pushbutton 14. Pressing the centre pushbutton sets the control parameter to the displayed value and the value stops flashing.

In the exemplary menu of figure 12, main menu 60 provides three selectable subsidiary menu options 61, 62 and 63 respectively designated Eye Menu, Cycle Menu and Display Menu. The Eye menu 61 provides three selectable options in addition to the back option which enable the bolt detection level, empty breech detection level and ball detection level to be calibrated. Detection is optical and optical characteristics can vary from paintball marker to paintball marker causing variation in generated signal levels. Calibration takes account of these variations.

The Cycle menu 62 provides five selectable options in addition to the back option. They are the sear solenoid on time, cocking solenoid on delay, cocking solenoid on time1, which have already been referred to earlier in the description of the operation of the sear and cocking solenoids 26 and 36, and cocking solenoid on time 2 and sear solenoid on delay which relate to an operating mode where the breech sensor is switched off. The Display menu 63 enables the brightness level of the display 16 to be altered to suit personal requirements.

It will be appreciated that the above embodiment has been described by way of example only and that many variations are possible without departing from the scope of the invention. For example, the paintball marker may be operated in other modes than those described.

CLAIMS

1. A grip frame for a paintball marker or the like comprising a handle, a trigger mechanism associated with the handle comprising a trigger and an electronic sensor associated with the trigger for determining when the trigger has been activated.

2. A grip frame as claimed in claim 1, in which the sensor is optical.

3. A grip frame as claimed in claim 1 or 2, in which stop means are provided for limiting the travel of the trigger.

4. A grip frame as claimed in claim 3, in which the stop means comprise two adjustable stops limiting the travel in opposite directions.

5. A grip frame as claimed in any preceding claim, in which magnetic means are provided operative to urge the trigger back to its rest position.

6. A grip frame as claimed in any preceding claim in which display means are disposed on the handle on that face thereof facing the user in normal use.

7. A grip frame as claimed in claim 6, in which the display menus comprise a light emitting diode (LED) display.

8. A grip frame as claimed in claim 6, in which the display means comprise a liquid crystal display.

9. A grip frame as claimed in claim 7 or 8, in which the display is a multicharacter display.

10. A grip frame as claimed in any preceding claim, in which pushbutton switches are provided in the handle for calibration purposes.

11. A grip frame as claimed in any preceding claim, which is made of metal.

12. A grip frame as claimed in any of claims 1 to 10, which is made of plastics.

13. A grip frame as claimed in any of claims 1 to 10 which is made of a combination of metal and plastics.

14. A grip frame substantially as hereinbefore described with reference to figures 2 to 11 of the accompanying drawings.

15. A paintball marker comprising a breech, barrel and grip frame as claimed in any preceding claim.

16. A paintball marker comprising a sensor for sensing the presence of an object in the breech.

17. A paintball marker substantially as hereinbefore described with reference to figures 2 to 11 of the accompanying drawings.

ABSTRACT

(Figure 3a)

ELECTRONIC GRIP-FRAME FOR A PAINTBALL MARKER

A grip frame 21 replaces an existing grip frame 1 on a paintball marker in order to convert said paintball marker from a mechanically operated paintball marker into an electro-pneumatic paintball marker. The electronic grip frame 21 utilises an optical sensor in order to detect the operation of a trigger 29 and a second optical sensor to detect the presence of objects within the breech of the paintball marker. Electrical signals from these sensors are taken to an electronic circuit board 24, which controls the operation of two solenoids (one shown 26) in order to fire and re-cock the paintball marker. A user interface comprising pushbuttons 12, 13, 14 and a multi-character display 16, allows the user to define how the grip frame 21 functions.

FIGURE 1

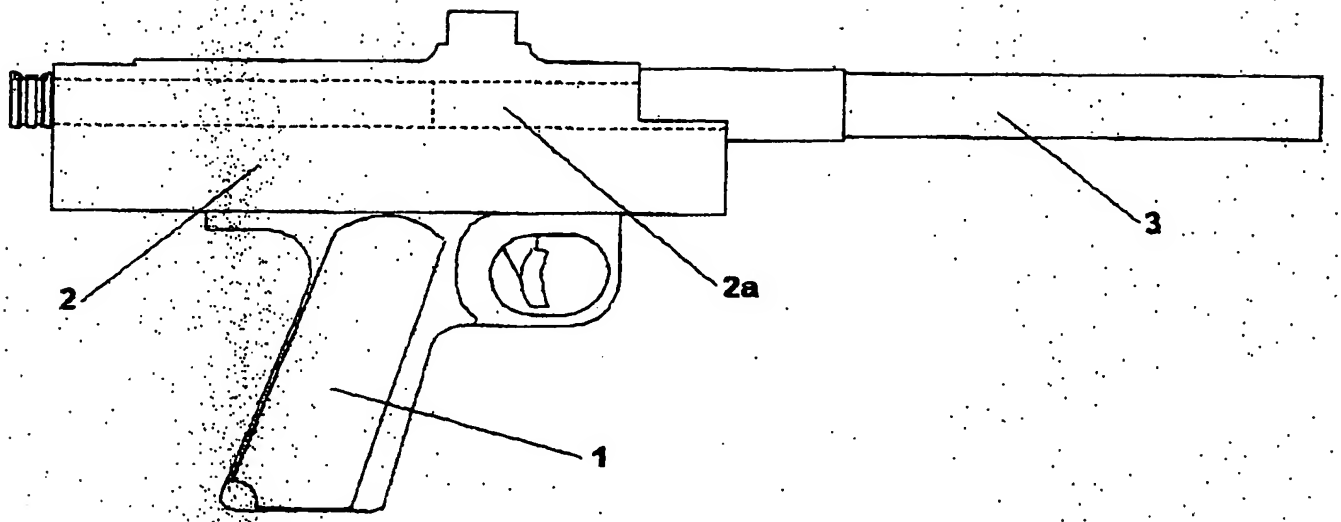


FIGURE 2

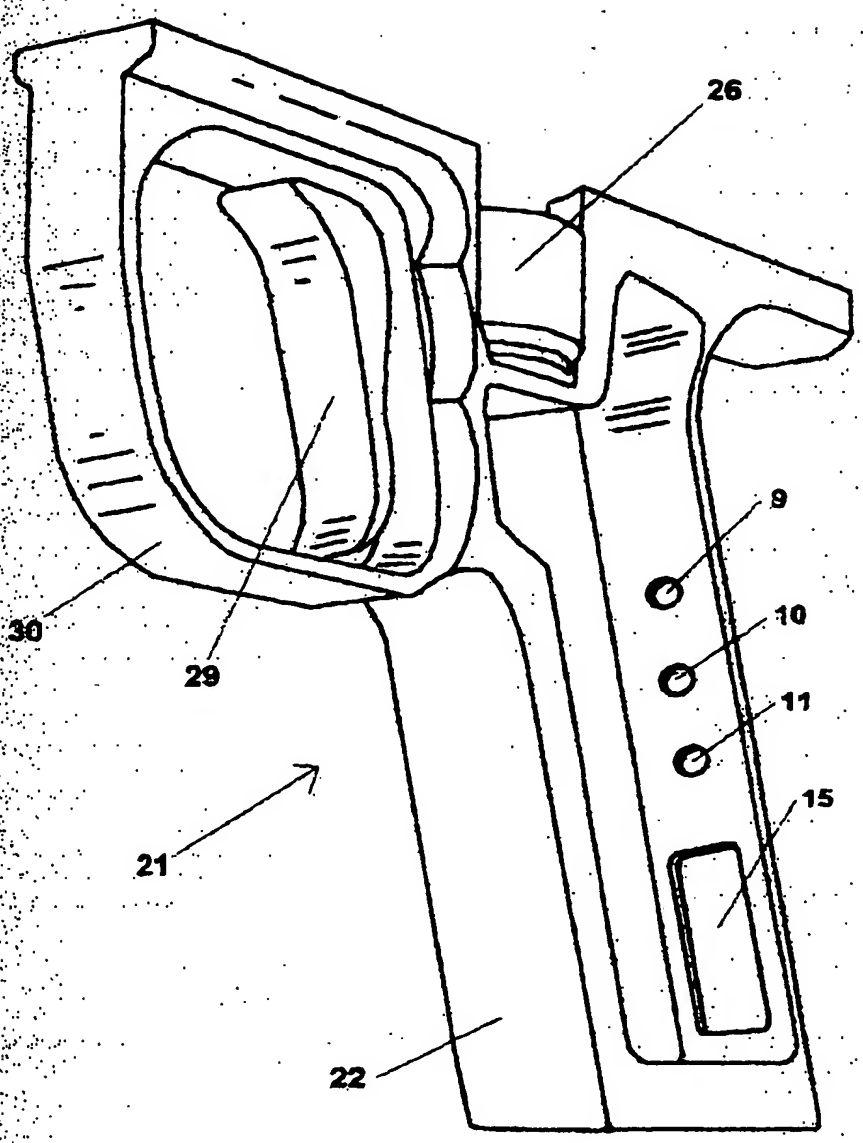


FIGURE 3c

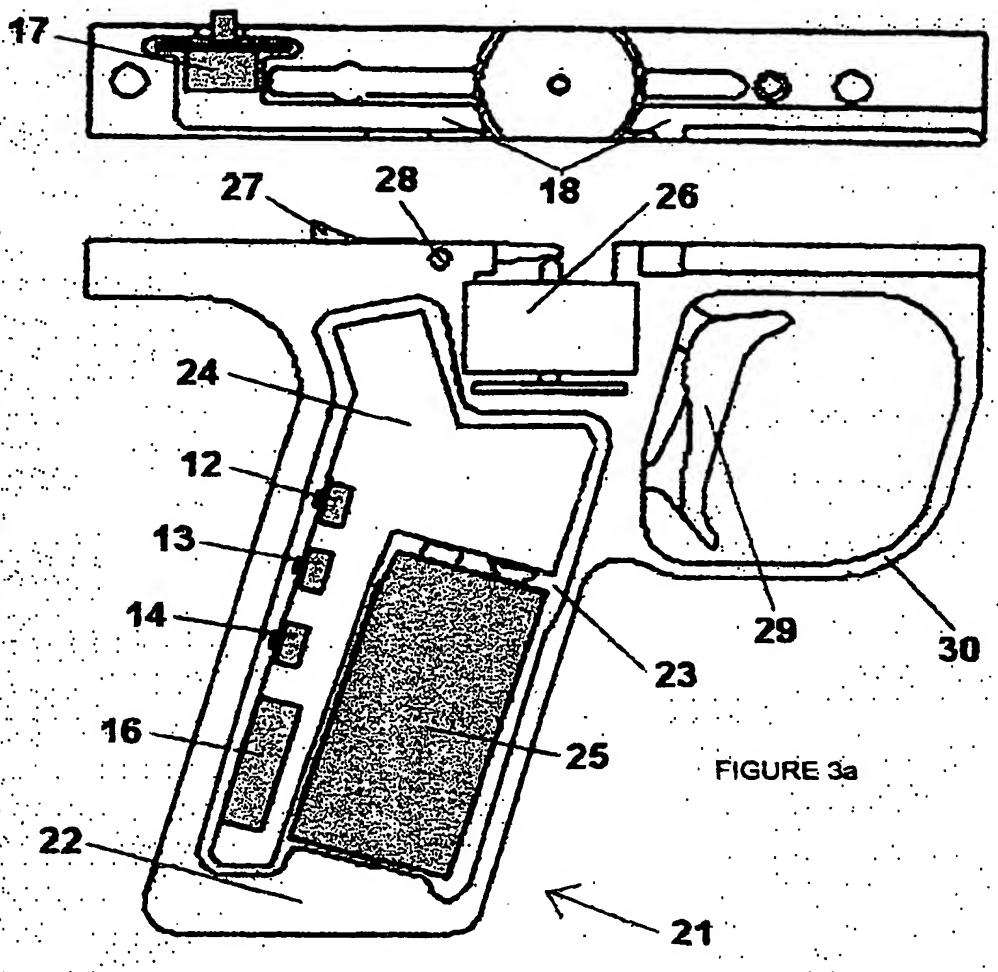


FIGURE 3a

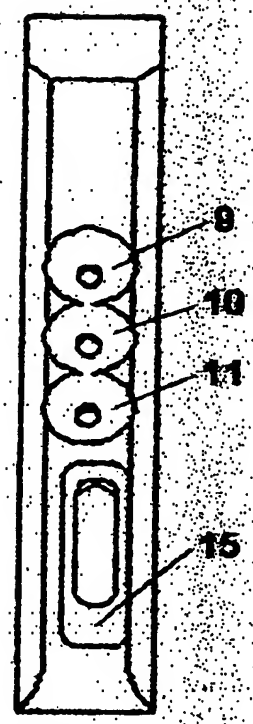


FIGURE 3b

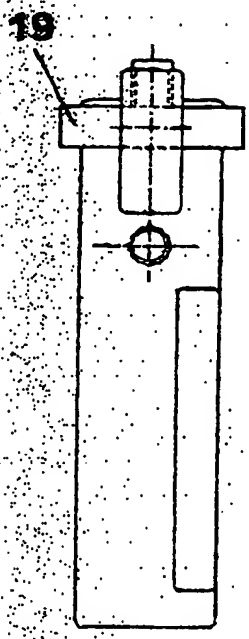


FIGURE 4b

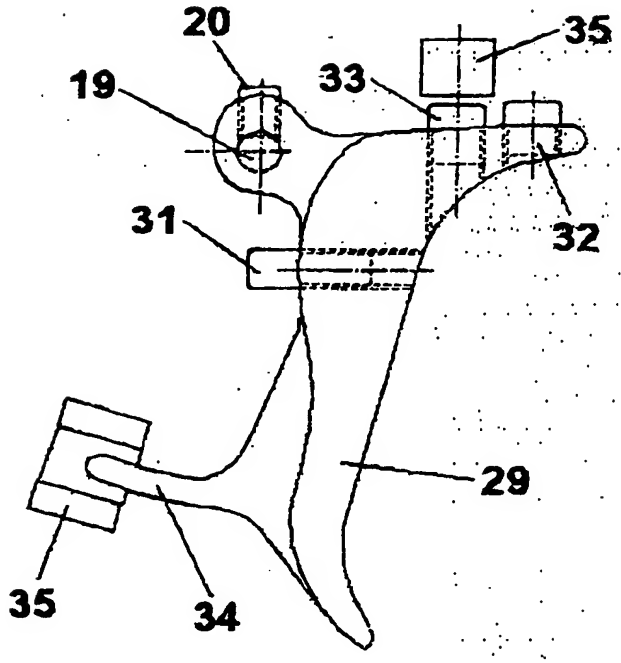
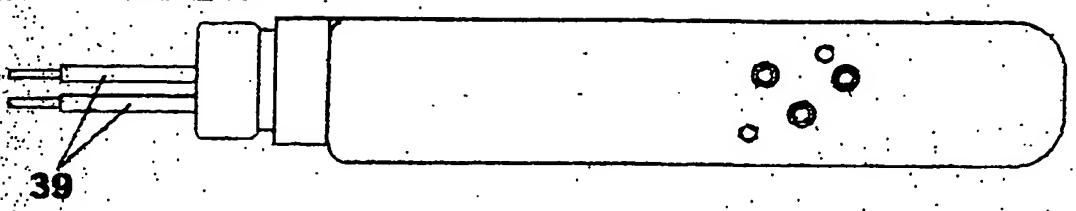


FIGURE 4a

FIGURE 5b



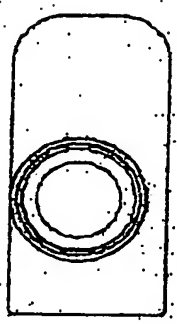


FIGURE 5d

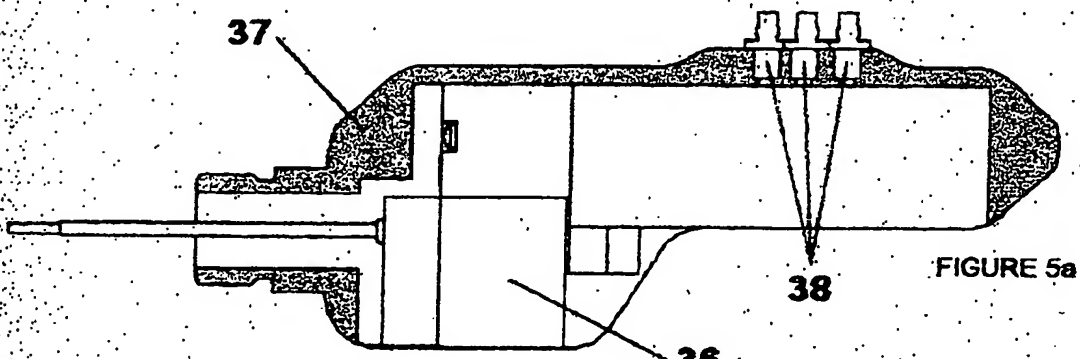


FIGURE 5a

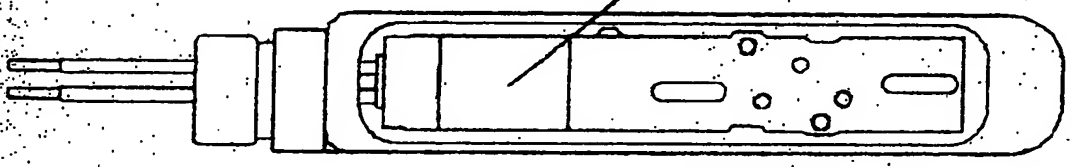


FIGURE 5c

FIGURE 6

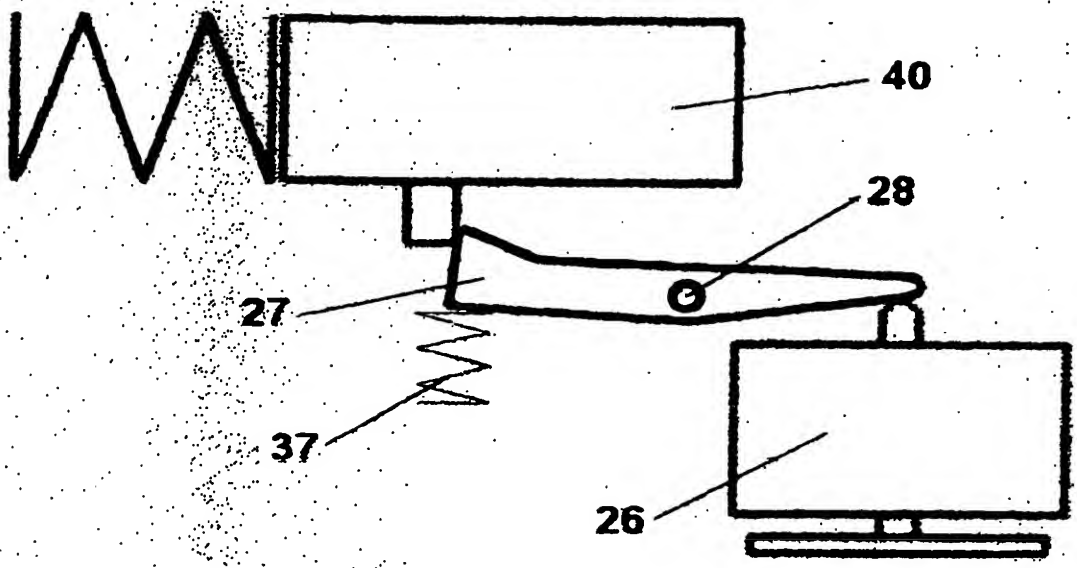


FIGURE 7

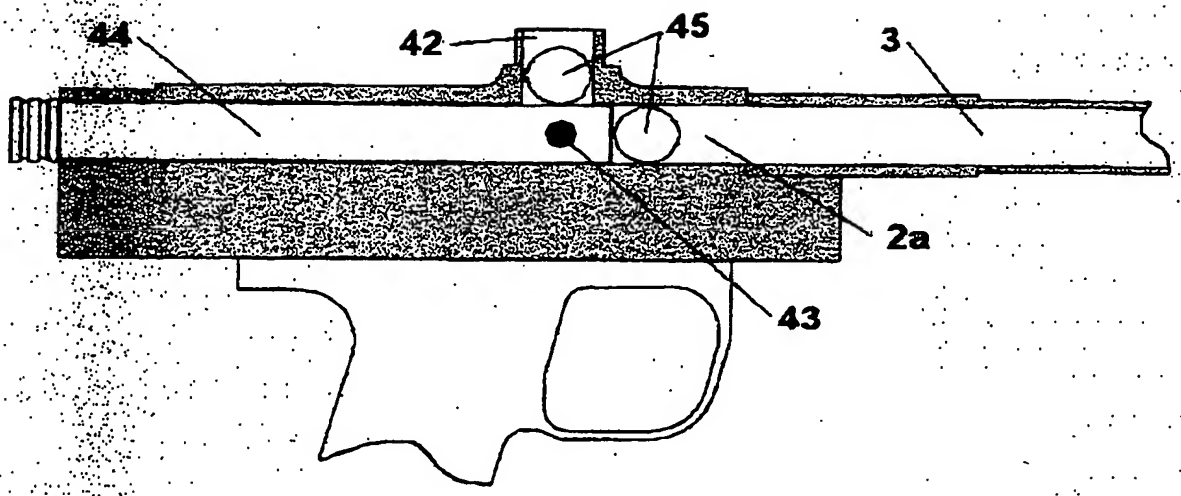


FIGURE 8

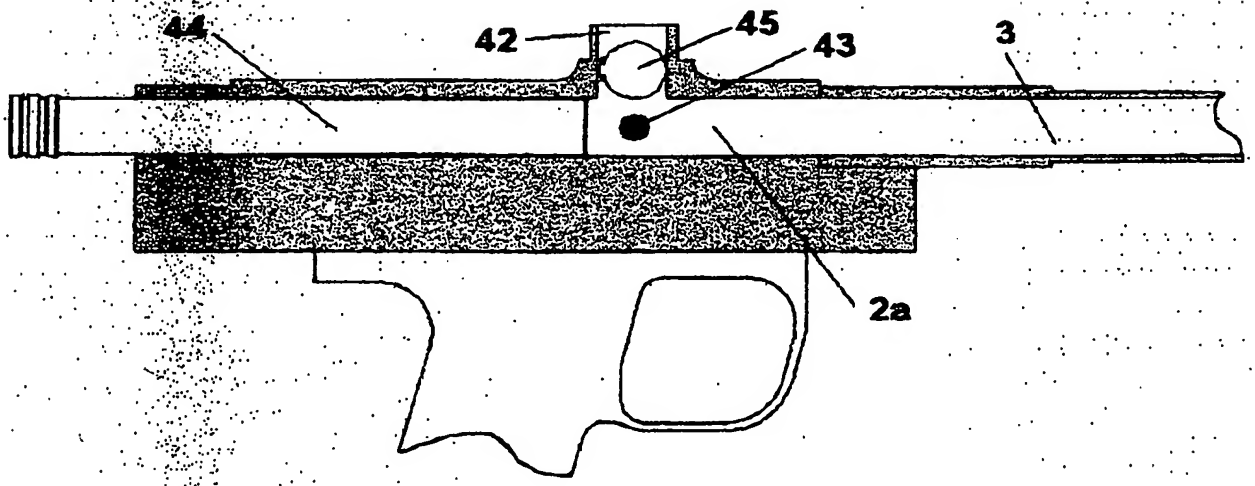


FIGURE 9

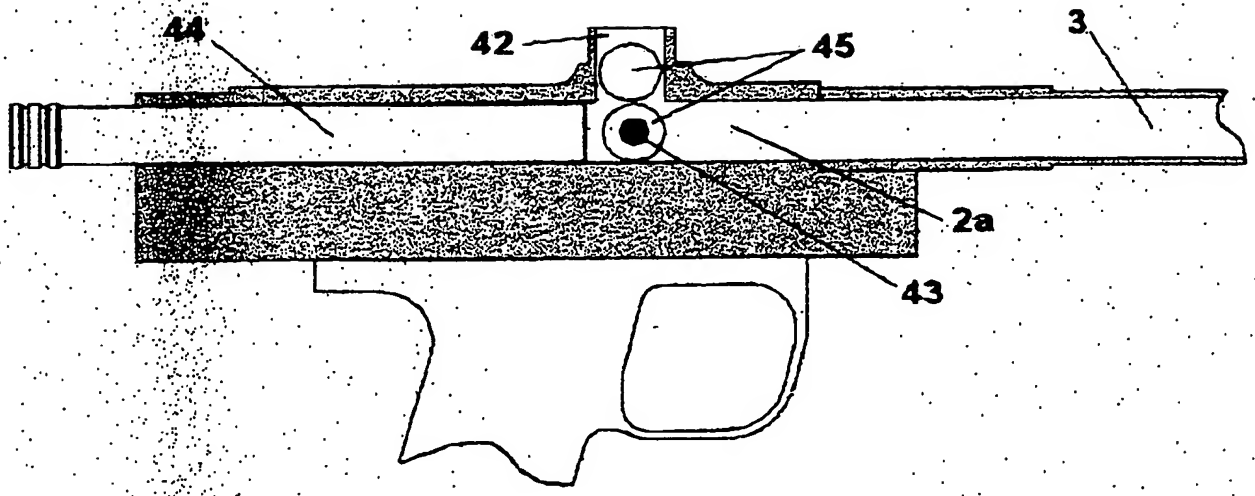


FIGURE 10

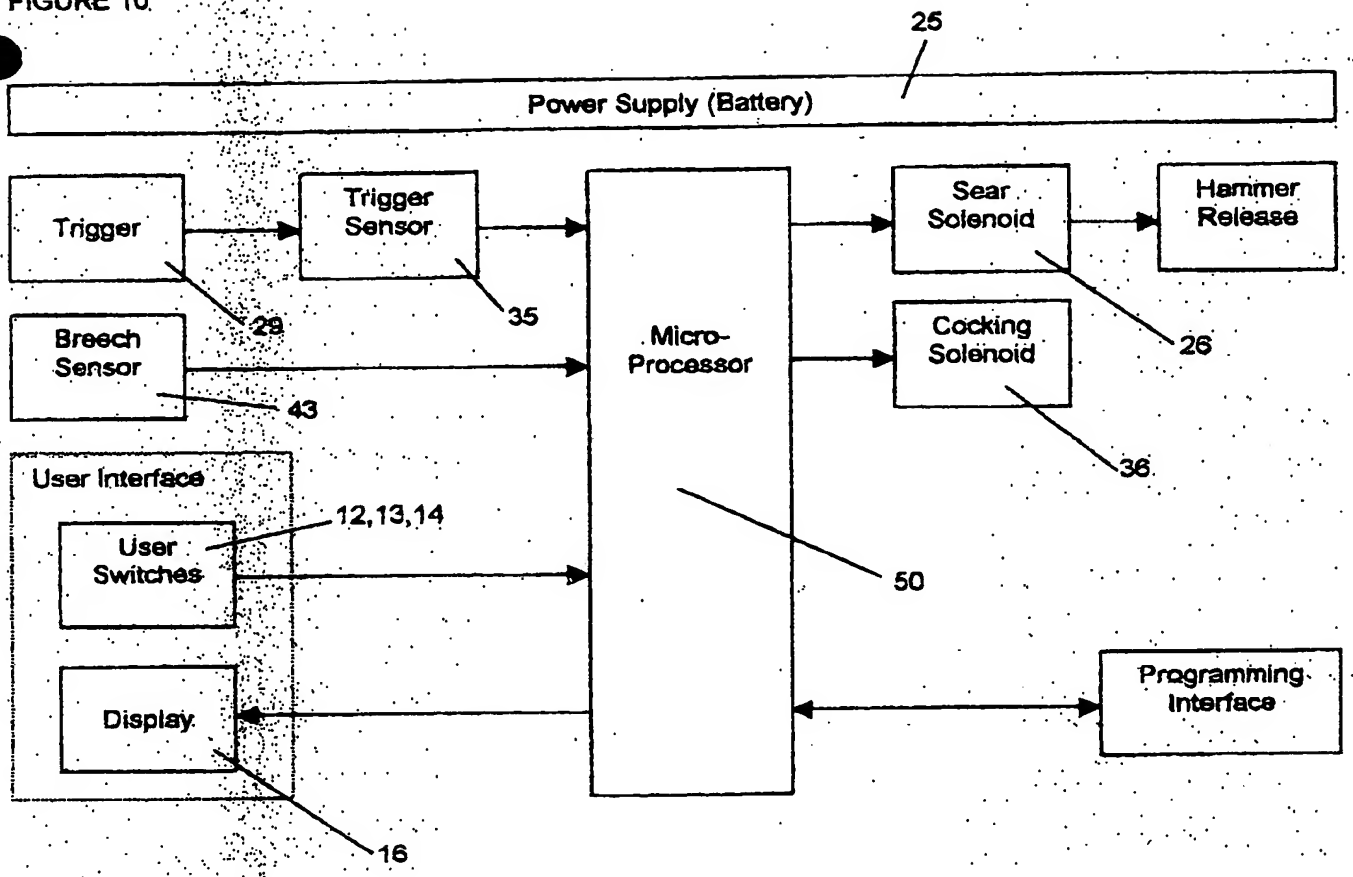

25
Power Supply (Battery)
Trigger
Trigger Sensor
29
35
Breech Sensor
43
Micro-Processor
Sear Solenoid
Hammer Release
26
Cocking Solenoid
36
User Interface
12,13,14
User Switches
50
Display
16
Programming Interface

FIGURE 11a

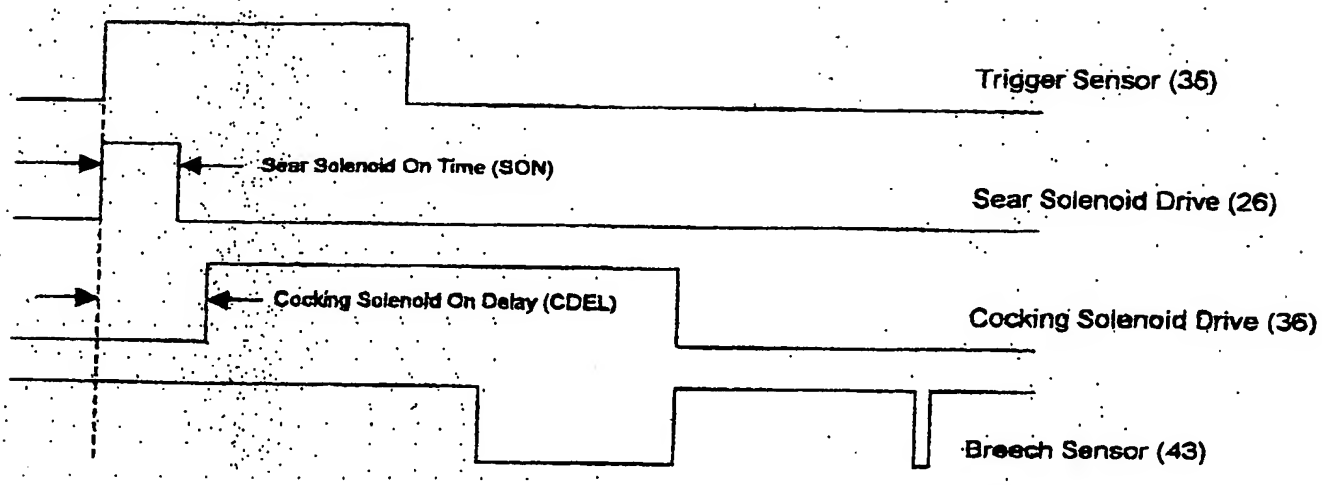


FIGURE 11b

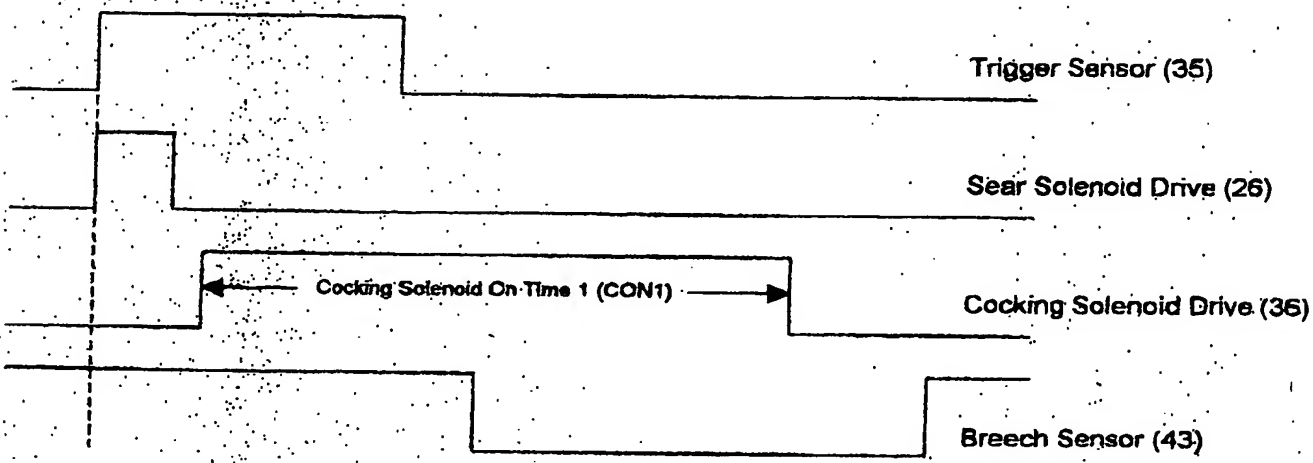
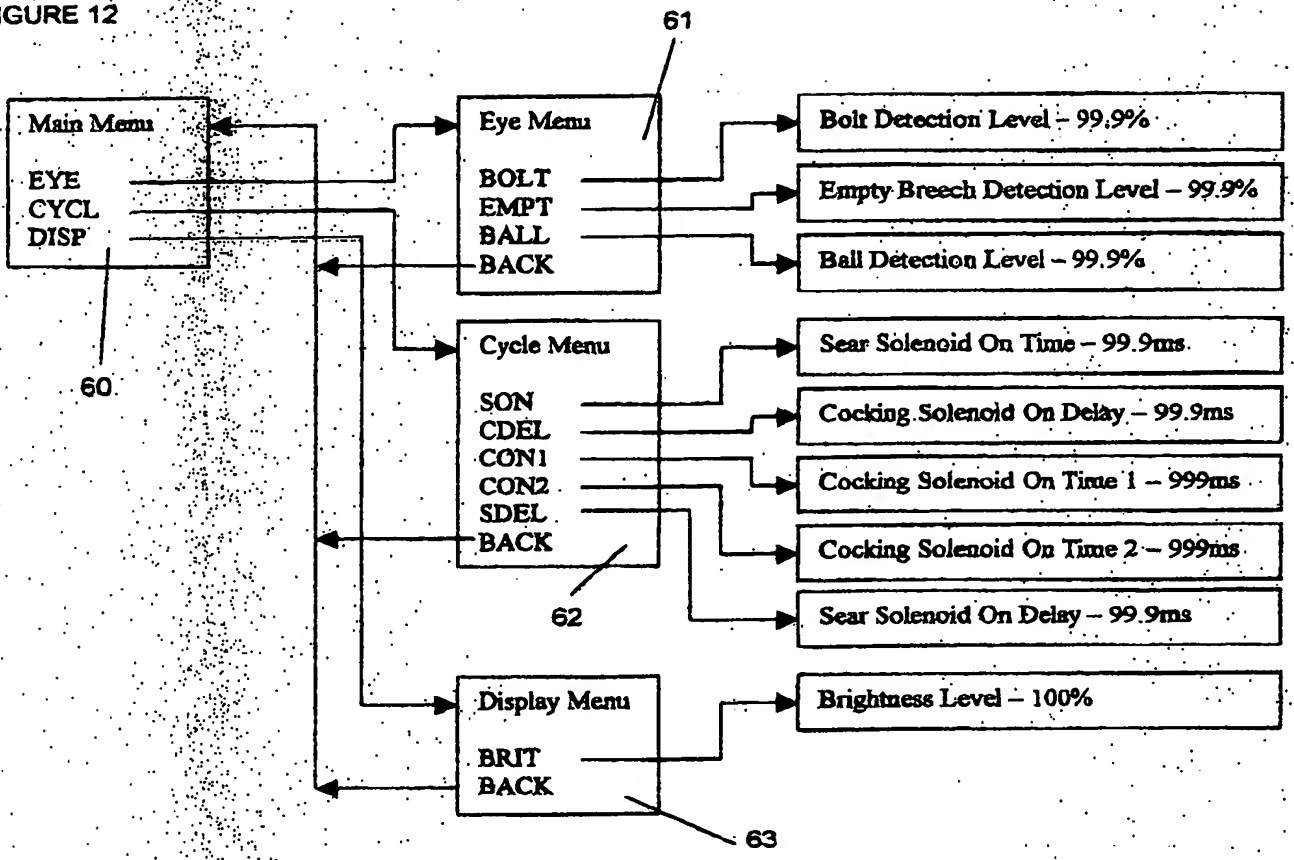


FIGURE 12


Main Menu
EYE
CYCL
DISP
60
Eye Menu
BOLT
EMPT
BALL
BACK
61
Bolt Detection Level – 99.9%
Empty Breech Detection Level – 99.9%
Ball Detection Level – 99.9%
Cycle Menu
SON
CDEL
CON1
CON2
SDEL
BACK
62
Sear Solenoid On Time – 99.9ms
Cocking Solenoid On Delay – 99.9ms
Cocking Solenoid On Time 1 – 999ms
Cocking Solenoid On Time 2 – 999ms
Sear Solenoid On Delay – 99.9ms
Display Menu
BRIT
BACK
63
Brightness Level – 100%